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ABSTRACT

A project to improve higher level thinking skills of elementary students in Hillsborough County, Florida is reported as a feature article (66p). An introductory overview chapter reviews the literature on teaching thinking skills. Chapter 1 provides background information on the community and the two schools selected for the practicum. The second chapter documents the problem and reports on efforts of the Academically Gifted Program to train teachers of the gifted in higher level questioning skills. Chapter 3 identifies terminal objectives of the study (i.e. improve the percentage of higher level questions asked by teachers). The fourth chapter reviews the implementation plan including meetings with teachers, brainstorming using the Delphi technique, use of a video-based staff development program, development of school goals by each school's study team, and conducting a summer seminar on thinking skills. Evaluation results showed all project objectives were met. The final chapter looks at future directions. Appended are the observation system used for the evaluation phase, teacher and administrator self-reflection checklists, suggestions for extending students' thinking based on Benjamin Bloom's model, and suggestions for improved questioning by teachers. Also included in this bulletin issue are two very brief contributions by John Pollman on the related topic of critical thinking: "Can Critical Thinking Be Taught in a Vacuum?" (4p.) and "Critical Thinking Instruments: Instruments of Plenty or Plenty of Instruments?" (5p.). (DB) critical thinking instruments. (DB)

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DEVELOPING A LONG-RANGE PROGRAM TO IMPROVE HIGHER-LEVEL THINKING SKILLS IN HILLSBOROUGH COUNTY SCHOOLS

By Eileen Duval and Earl Whitlock

and

CAN CRITICAL THINKING BE TAUGHT IN A VACUUM? CRITICAL THINKING INSTRUMENTS: INSTRUMENTS OF PLENTY OR PLENTY OF INSTRUMENTS?

By John Follman

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F.E.R.D.C. NOTES ON THIS EDITION

With the education reform movement, tremendous pressure has been brought to bear on students to achieve or master content, primarily that which is measured by norm referenced tests. Teachers have felt that the burden of proof of their efforts is also measured on what test data on their students indicate. With all the effort to measure content, one often encounters knowledgeable students who can recall knowledge well enough but is not skilled in thinking and problem solving. Many educators are very much concerned with this deficiency. The literature is beginning to reflect this concern. These authors — Duval, Whitlock and Follman — are contributors to the growing number of articles written about this most important goal of liberal education. F.E.R.D.C. is pleased to have the opportunity to make them available to our readers.

CHARLIE T. COUNCIL
Executive Director

DEVELOPING A LONG-RANGE PLAN TO IMPROVE HIGHER-LEVEL THINKING SKILLS IN HILLSBOROUGH COUNTY SCHOOLS

by

Eileen Duval
Earl Whitlock

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DEVELOPING A LONG-RANGE PLAN TO IMPROVE HIGHER-LEVEL THINKING SKILLS IN HILLSBOROUGH COUNTY SCHOOLS: A REVIEW OF THE LITERATURE

PART I

by

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Gifted/Talented Program

Earl Whitlock, Supervisor
Elementary Science

Not since Sputnik has education received such widespread attention and public concern as in the past few years. At the state, regional and national level this concern is evident through the numerous commissions, task forces, reports by the Secretary of Education, TV documentaries and legislation that have focused attention on education. Quality education for all students has been the subject of this renewed interest. Costa (1985) writes that . . .

> Helping students become effective thinkers is increasingly recognized as a primary goal of education. Rapid expansion of knowledge points to the importance of curriculums that empower students to locate and process knowledge rather than simply memorize facts. The most recent Gallup Poll asked teachers and the public to rate goals of education as to their importance. At the top of teacher ratings and near the top of public ratings was the ability to think creatively, objectively, and analytically. When John Goodlad surveyed teachers, parents and students, he found that intellectual development of students was consistently identified as the most important goal of schooling.

Reports at the national level identify higher-order questioning and thinking skills in science and mathematics as major areas of neglect in the curriculum. For example, the National Commission on Excellence in Education reported the following documented indicators of the problem:

> *over half the population of gifted students do not match their tested ability with comparable achievement in school.
>
> *the number and proportion of students demonstrating superior achievement on the SAT's have dramatically declined.
>
> *many seventeen-year-olds do not possess the "higher-order" intellectual skills we should expect of them. Nearly forty percent cannot draw inferences from written material.
>
> *there was a steady decline in science achievement scores of U.S. seventeen-year-olds as measured by national assessments of science in 1969, 1973 and 1977 (*A Nation at Risk* , 1983, p. 8-9).

In another example, The Education Commission of the States 1982 Report lists the "Basics" of tomorrow as follows:

*Evaluation and analysis skills
*Critical thinking
*Problem-solving strategies
*Organization and reference skills
*Synthesis
*Application
*Creativity
*Decision-making
*Communication skills

A review of the literature revealed a vast amount of information and references available on critical thinking. Innumerable books, articles and even whole courses were devoted to the topic of thinking skills. An initial ERIC search revealed more than 8,000 articles available on thinking skills. Limiting the search to information written in 1985 and later, reduced the number of references to more than 100. A review of the research revealed that many of the reports on American education today are negative, strident and critical. We encounter not a search for excellence, but a search for error. Research findings indicate that such things as teachers being drawn from the lowest group of college students, students not being challenged, subjects not being intellectually rigorous, curricula being poorly designed, schools being dull, and products that are defective, all contribute to what's wrong. "A Nation At Risk" made recommendations that were more directed at assigning blame than in making certain that schools improved. This report, "A Nation At Risk," recommended:

1. longer school day and longer school year
2. more basics and fewer electives
3. more homework
4. tougher discipline
5. higher expectations

Contrary to education's approach, Thomas J. Peters and Robert H. Waterman, Jr., in their best-book, *In Search of Excellence* (1982), set out to find out what was right with American business and to pass along "Lessons from America's Best-run Companies." Peters and

Waterman identified three major characteristics in excellent business companies that McDaniel (1984) stated can be used by principals to get similar results:

1. The most important and visible outcropping of the action bias in the excellent companies is their willingness to try things out, to experiment . . . . In many of these companies the standard operating procedure is "Do it, fix it, try it."

- The principal can become action-oriented in solving problems.
- The principal can take complex problems and break them into manageable "action units" to be assigned to various task forces.
- The principal can promote informality and open communication.
- The principal can encourge experimentation.

2. The fact that these companies are so strong . . . . comes in large measure from paying attention to what customers want. From listening. From inviting the customer into the company. The customer is truly in partnership with the effective companies, and vice versa.

- The principal can respond quickly to complaints.
- The principal can look at dissatisfaction with school services from the consumer's point of view.
- The principal can emphasize feedback from his customers, the students.
- The principal can make sure that all staff members contribute to customer satisfaction.

3. These companies give people control over their destinies; they make meaning for people. They turn the average Joe and the average Jane into winners. They let, even insist that, people stick out. They accentuate the positive.

- Principals can support and reward teachers, unshakling them and asking them to shine.

- Principals can examine rewards and punishments for teachers.

- Principals can accentuate the positive in teacher evaluations.

thinking Principals can use the temporary task force approach to share leadership opportunities and responsible decision-making.

- Principals can be tough. Productivity through people includes high expectations, high goals, performance measurements and achievement orientation.

In our search for educational excellence, we might be best served by looking for what is *right* in education. Teacher-effectiveness research addressed several ways in which we promote learning of basic skills and higher-level mental processes.

1. Vary question levels.
2. Probe, rephrase, prompt.
3. Wait for some response.
4. Provide answer to question.
5. Ask process questions.
6. Stress student's understanding of meaning.

The research clearly revealed that teaching thinking as a subject in schools was becoming a major trend. The promotion of thinking skills should be deeply embedded in the whole fabric of an instructional program. Educators must encourage and challenge thinking. However, according to most advocates of critical thinking, there existed no neat set of recipes for fostering critical thinking in students.

Thinking critically can be defined as rationally deciding what to do or believe. Being a critical thinker implies assessing the views of others and one's own views according to acceptable standards of appraisal.

Recent work by philosophers of education such as McPeck and Siegel provided justification for teaching critical thinking. According to their view, critical thinking was not just another educational option. Rather, it was an indispensable part of education, because being able to think critically is a necessary condition for being educated, and because teaching with the spirit of critical thinking is the only way to satisfy the moral injunction of respect for individuals, which must apply to students as well as to anyone else (Norris, 1985).

Increased interest in the teaching of thinking skills and, in particular, the desirability of teaching them explicitly came, in large part, from concerns about documented failings of the current system. (Entering college students not prepared to do the kind of thinking that college experiences required.) In recent years, considerable research was done on human thinking: reasoning, problem-solving, decision-making, and metacognition. Even so, many people are not yet convinced that there is a need to include thinking in the curriculum. Costa (1985) cited the following common trends of thought regarding the need to teach students to think:

- Don't we already teach students to think?
- Of course, I teach thinking; why just yesterday I gave my students a lecture on the importance of thinking critically.
- Please don't add anything more to the curriculum. We can't cover all that we're supposed to now!
- Why don't teachers just tell us the answers they want us to have?
- Is this one of those "sensitive subjects" I'm supposed to give my child permission to participate in?

The literature indicated that putting greater emphasis on the teaching of thinking skills in the classroom was a healthy development in U.S. schools. However, one should bear in mind that the field remains wide open and that there needs to be a great deal of experimentation before really satisfactory results can be obtained.

"Do we need special approaches to the teaching of thinking skills?" Nickerson (1984), stated that thinking is a totally knowledge-dependent activity; to *think*, one must think *about something*. He then pointed out that the acquisition of thinking skills has sometimes been contrasted with the acquisition of knowledge. It was Nickerson's contention that we need to be shown HOW to think in more productive ways. A reasonable goal of education, then, would be to make students more aware of the importance of stopping to think before acting — leaving THINK undefined and motivating them to adopt a reflective attitude and a deliberate approach to daily problems and decision situations as a matter of habit.

Teachers can promote intellectual exploration of new ideas through verbal interaction with students. Barrell (1985) stated that certain teaching strategies — presenting information, making certain it is received, and recalling it on demand — are in order if thinking is the "accumulation of knowledge." If thinking is the "quest for meaning" as opposed to the "thirst for knowledge" that is verifiable primarily through rules of logic, then it is a process of searching for and creating meaning, involving the mind's creations — symbols, metaphors, analogies — in an attempt to establish relationships between the world of particulars and the ideas and concepts that give them structure.

The categories of Bloom's Taxonomy (Knowledge, Comprehension, Application, Analysis, Synthesis, Evaluation) have been used as a framework for viewing the educational process and analyzing its workings as well as for analyzing teacher's success in classroom teaching. Paul (1985) stated to learn how to think critically is to learn how to ask and answer questions of analysis, synthesis, and evaluation. He further stated that teachers should have a solid foundation in critical thinking skills if they are expected to teach them. The achieving of any knowledge always presupposes at least minimal comprehension, application, analysis, synthesis, and evaluation. It was Paul's belief that successful critical thinking instruction required that:

- teachers have a full range of insights into cognitive processes and their complex inter-relationships.
- Bloom's hierarchy becomes two-sided.
- teachers grasp that rational learning is *process*- rather than *product* oriented- a process that brings comprehension, analysis, synthesis and evaluation into every act of the mind that involves the acceptance of beliefs or claims to truth, and that fosters thereby rational habits of thought and rational learning.

Thinking skills are not one way upward in development; for instance, that analysis must come before evaluation and synthesis. Rather, it is more logical to think that there is interchange between all three skills; analysis requires evaluation and synthesis; evaluation requires analysis and synthesis, etc. (Paul, 1985).

The research indicated it was not necessary to have a separate course on critical thinking. Strategies for improvement of thinking skills could be incorporated into existing curriculum materials and courses (Strong, Silver, Hanson, 1985). Joyce (1985) advocated teaching thinking skills in conjunction with the content areas and not as a separate program.

In his analysis of a variety of approaches that districts use to implement the teaching of thinking, Bereiter (1984), reported that two methods that are usually unsuccessful were:

- teaching thinking as subject matter.
- teaching thinking skills as enrichment.

Two ways to successfully teach thinking skills were:

- make thinking skills activities an integral part of other, already-accepted instructional objectives.
- permeate the instructional program so thoroughly with thinking skills activities that they can't be isolated and reduced to verbalized subject matter.

In presenting models for teaching thinking, Joyce (1985) supported Bereiter's pervasive approach which suggested pervading the curriculum with intellectual process so that the teaching of thinking is an important component of every school activity. In support of this approach, Joyce stated that:

- there is a storehouse of models of teaching that directly teach both content and intellectual process.
- these models of teaching result in more effective teaching of the basic school subjects than the methods generally employed to teach them.
- teaching basic subjects in such a way that thinking is enhanced avoids the traditional dichotomies between the content of education and intellectual activity.

Teaching the basic subjects without teaching thinking simultaneously would be inefficient and would neglect thinking. In order to teach students how to think and learn in a certain way, a regularly used program needed to be established. This program would need to be taught to students. To do this would require patience. When we

teach students to reason independently, we increase their ability to teach themselves and we must share this ability in the instructional situation.

Strategies for thinking do not come in fragments. We teach thinking strategies that include particular skills, such as how to observe, but the observations are used in relation to other skills. Research indicated that thinking strategies were most effectively taught in conjunction with appropriate content. The biggest problem educators faced was that teaching thinking required that we teach the core subjects differently. To do such would require strong staff development programs.

Perkins, Smith and Nickerson (1984) found it convenient to group programs to teach thinking in five categories:

1. Cognitive-process approaches.
2. Heuristic-oriented approaches.
3. Approaches that focus on the development of formal thinking in the Piagetian sense.
4. Approaches that emphasize language and symbol manipulation.
5. Approaches that focus on thinking as subject matter.

Programs with cognitive-process approaches include Instrumental Enrichment, Structure of the Intellect (SOI) and Science — a Process Approach (SAPA). Programs with heuristic approaches include Productive Thinking, Patterns of Problem-Solving, and "operations" in Cognitive Research Trust (CORT). Programs such as QUEST and Talents Unlimited reported that inservice training programs were effective keys to improve critical thinking. Mastery Learning, which features curriculum materials in units, criterion-referenced tests, and a diagnostic remediation cycle was found to be better on measures of student outcomes in critical thinking (Holdzkom, 1984). The Think Program or Strategic Reasoning Program was based on the premises that students can learn the relationship between words and things and that they can learn new words and ideas. Used with Chapter 1 students in a middle school, there was an average gain of seven months in reading and five months in math for 287 students in Tulsa (Zenke, Alexander, 1984).

Evidence regarding the effectiveness of specific programs for teaching thinking was sparse. There were many factors that contributed to this dilemma:

- programs are too new and we have not had time to properly evaluate what is available.
- educational evaluation is inherently difficult, and results are seldom unequivocal.
- program developers have not been motivated to evaluate their programs.

The research indicated that before teachers use a strategy, it is important for them to model and practice the kinds of thinking used in the strategy. Teachers should choose a strategy that matches either the style of the content objective they are teaching or the style of thinking with which the learner is most comfortable.

In their article dealing with the integration of strategies and thinking styles, Strong, Silver and Hanson (1985) cited five principal goals of education:

1. Mastery - development of a high level of competence in basic skills.
2. Understanding - development of the ability to use reason and higher-level intellectual and academic skills in content work.
3. Synthesis - development of the ability to create new and original work and apply intellectual and basic skills to new contexts.
4. Involvement - development of the ability to find relevance in learning and to move toward an "academic maturity."
5. Cultural literacy - knowledge of a body of culturally important information.

In summary of their findings, Strong, Silver and Hanson (1985) made the following statements:

- Evaluation data that are available on teaching thinking skills are not sufficient to conclude that any given approach is either much better or much poorer than all the others.

- Quantitative data make it clear that no one can yet assure the development of effective thinking skills in the classroom.

After their review of the literature, the writers concur with Norris (1985) who synthesized the research on critical thinking skills, by highlighting the following:

1. Critical thinking is a complex of many considerations.
2. Critical thinking is an educational ideal.
3. Critical thinking ability is not widespread.
4. Critical thinking is sensitive to context.
5. Teachers should look for the reasoning behind students' conclusions.
6. Simple errors may signal errors in thinking at a deeper level.
7. Having a critical spirit is as important as thinking critically.
8. To think critically, one must have knowledge.
9. We do not know a great deal about the effects of teaching critical thinking.

Chapter 1

BACKGROUND

Hillsborough County is a community centrally located on the west coast of Florida. The area consists of Tampa, a large urban city, and several outlying municipalities: Brandon, Ruskin, Apollo Beach, Plant City, Lutz, Temple Terrace and Wimauma. As a composite, these individual cities contribute to the cultural and economic diversity found in Hillsborough County. Spanish cuisine and Ybor City's historical district, complete with cigar factories, reflect the rich Latin culture, while Wimauma is characterized by migrant farmers, Plant City by its strawberry heritage, and Brandon by young urban professionals.

Hillsborough County is making a transition away from its small-town atmosphere of the past to a fast-growing area with rapid change and a transient population. Tampa has become the regional, financial, service and distribution center for the Florida west coast market area. There are 1,400 wholesale distribution firms, 700 manufacturing firms and over 48 companies that employ over 300,000 people. The community's growth and complexity are further illustrated by having in the area two colleges and two universities, MacDill Air Force Base, professional athletics, a new waterfront market (Harbour Island), the Port of Tampa and the widely acclaimed Tampa Airport.

Tampa's rapid growth has had a direct effect on the school system. It is the twelfth largest public school system in the U.S. and the third largest in Florida. The school system operates 131 schools with 59,000 students enrolled in 93 elementary schools.

Two schools, School A in Brandon and School B in North Tampa, were selected for this practicum. School A was described as having a declining enrollment, having a student population in transition from one of predominantly high-ability-level students to students of more average ability, and having a population with a representative racial mix. School B, located in an affluent community, was described as having a large number of high-ability students, and having an expanding gifted-student population. Both schools were characterized by a high percentage of parent participation.

There was a desire on the part of both schools to constantly grow and seek high levels of excellence in their programs. For this reason, coupled with administrative and teacher interest in improving high-level thinking and a representative range of student abilities, the two schools were selected to participate in a study of critical thinking skills.

Chapter 2

IDENTIFICATION AND EVIDENCE

a. General Statement of Problem

One of the most powerful aspects of an education is to enable learners to develop their intellect to the highest level possible. Furthermore, to have schools of excellence presupposes that major attention be given to maximum development of students' mental abilities. Therefore, as a result of an examination of the district curriculum materials, low district scores in reading comprehension, and the lack of a systematic training program in higher-order questioning, this study represented an initial attempt to identify and develop a model to improve student higher-level thinking skills and to improve teacher knowledge and competence in the use of higher-level questions in the classroom.

b. Detailed Documentation

In Hillsborough's elementary schools, there is a limited amount of higher-level-thinking-skills data available on the regular classroom. Nevertheless, evidence of need is indicated by low-reading comprehension scores on the California Test of Basic Skills (CTBS), by lack of a systematic training program for teachers on higher-order thinking, and by the lack of depth in curriculum materials.

District results on CTBS for the period 1981-1986 indicated reading comprehension scores have lagged behind achievement in both language and mathematics. The deficits in reading were attributed to a number of variables, but efforts to improve reading comprehension focused on improved teacher ability to teach thinking in reading.

The goal of teaching all students to read before they graduate high school is the stated aim of the superintendent. In support of the superintendent, the school board, the assistant superintendents and the director of elementary and secondary education gave strong support to the *1985-86 District Reading Report*. The reading report established the following mission for the school year.

> By creating a learning environment that maximizes each student's potential, the Hillsborough County School

> Systems will develop lifelong readers who read widely for information and enjoyment. All children will be exposed to good literature through listening and reading and will develop written and oral expression competencies in all curriculum areas.

A lack of higher-order questions in curriculum materials was a definite concern. As teachers in the Academically Gifted Program (AGP) examined mathematics and science textbooks during the 1985-86 school year, they found that the overwhelming majority of questions in the textbooks were at the comprehension level on Bloom's Taxonomy. If higher-level questions were to be addressed, teachers had to be skilled enough to integrate these higher-level thinking skills into the curriculum. Further evidence documenting the need to improve teacher knowledge and skills with higher-order thinking was stated by James Bellanca in a response to a question about teachers' ability to use higher-level questions (Costa, 1985):

> If we expect every student to become a capable thinker, yes. The teachers questioning skills are a prerequisite to better thinking.

Since 1984, experiences with the AGP indicate a difference in the classroom can be achieved with higher-level thinking skills. For example, as reported in *The AGP Cycle VI Evaluation Report*, there was significant growth in the classroom in types and proportions of thinking skills in mathematics and science from 1984-85 to 1985-86. The change reflected in these results were obtained after attention was focused on the deficit and intervention strategies were implemented to correct the situation.

c. What Has Been Done About The Problem?

The problem of the amount of time students spend engaged with higher-level thinking and teachers using higher-level questions infrequently, has been addressed by the AGP. During the 1985-86 school year, teachers in the AGP participated in large and small group training sessions based on Bloom's Taxonomy. They studied the literature on thinking, had lessons modeled demonstrating the use of higher-level questions, and planned alterations to their lessons to include more higher-level questions. Prior to this training, teachers in the gifted science progam received sixty hours of training in physical

science, life science and earth/space science. The training involved not only science content but also training in the processes of science (hypothesizing, inferring, graphing, experimenting, etc.).

Aside from what was done in the AGP, there had not been a planned, consistent effort to address thinking skills for all students. Interest in a thinking skills program had been shown by several supervisors who had attended conferences on thinking and who had invited speakers to come to the district to make presentations. In June 1986, a national consultant in the area of thinking spoke to a group of Curriculum Intervention Specialists (CIS), and another consultant trained CIS's and teachers in Talents Unlimited for the social studies area.

In August, in response to the staff's interest and to avoid fragmentation of effort, the general director of Elementary Education appointed a task force to study the area of thinking. The appointment of the task force represents a significant step toward identifying effective ways to improve higher-level thinking skills throughout the district. The writers are serving as co-directors for the task force, which will prove valuable in the implementation of the practicum.

d. Probable Cause Of The Problem

Several related factors probably contribute to higher-level thinking being a problem in the schools. A primary cause was attributed to teachers never having received adequate training in using higher-order questions. Another cause is the fact textbooks, by and large, were the curriculum. Therefore, when the textbooks were minimal in scope, or lack giving attention to critical thinking skills, this was reflected in the student's curriculum. Much attention was also given to getting through the text rather than spending time to go into depth of study on a topic. It was only by taking time to treat study in depth, that teachers could begin to develop student higher-order thinking. The dependency on textbooks and lack of ownership by the teacher with what they were teaching may have created apathy toward providing quality, high-level experiences in the classroom.

Another, more critical, factor was that teachers took themselves out of the role of curriculum developers. This could be related to all the importance attached to minimum-skills testing. Teachers are so concerned that their classes do well on these tests that they neglect more enriched instruction. Further, teachers are not involved fre-

quently enough in curriculum decisions at the school level.

It was also apparent to the writers that there was a growing body of literature on thinking but not an easily identified route for a school system to take to improve their programs. Added to this, was the decision of whether a thinking-skills program should be integrated into subject areas, taught as a separate course, or taught as a combination of both. It was easy to see that there are no quick fixes to remedying the problem. Seeking "quick fixes" rather than developing sustained long-range plans proved another reason problems like this one persist.

Chapter 3

TERMINAL OBJECTIVES

Three terminal objectives were identified by the writers for the study.

1. As a result of using a collaboration model, based on Karolyn Snyder's School Effectiveness Model, during the period of September 1986 to May of 1987, the percentage of higher-level questions (analysis, synthesis, evaluation) asked by the teacher will increase by twenty percent of class time, as determined by a classroom observation instrument.

2. As a result of practicum intervention strategies used during the period September 1986 to May 1987, the percentage of time students use higher-level thinking skills in the classroom will increase by twenty percent of class time, as measured by an observation instrument.

3. As a result of strategies implemented during the period of September 1986 to May 1987, ninety percent of teachers involved with the study will show an increased awareness of higher-level thinking skills as measured by a pre/post Attitude/Awareness survey.

Chapter 4

IMPLEMENTATION OF PLAN

a. Introduction

The implementation plan for developing a long-range plan to improve higher-level thinking skills got its impetus in the spring of 1986 when the Department of Testing and Evaluation reported a significant gain in the classroom in the types and proportions of thinking skills in mathematics and science in the gifted program following intervention strategies focused on higher-order questioning. Supervisors in the Department of Elementary Education expressed interest in the area of thinking and, as a result, a district task force was established in August 1986 to investigate effective ways to improve higher-level thinking skills throughout the district. The writers served as co-chair of this task force.

The primary function of the writers, in conjunction with the study, was to assist in the review of the literature and research on the teaching of thinking skills. Each writer formed a study team composed of teachers, a principal and a curriculum/intervention specialist (CIS), developed a schedule of meeting dates, coordinated the dissemination of information, assisted with materials collection and cooperatively planned all activities for the study teams. In addition, the writers developed a classroom observation instrument and a teacher and an administrator survey. The writers trained the observer in the use of the observation instrument and assisted the observer in scheduling the classroom observations.

An essential part of the implementation plan was the formation of the district-level task force and the responsibility of the writers to co-chair that group. The writers worked closely with members of the task force to provide input and direction to assist in making decisions relative to the teaching of thinking in the district. The writers also participated in a School Effectiveness League (SEL), composed of a cadre of principals and district supervisors during the implementation year, and used the collaborative planning model learned in the training to assist the task force and study teams. The use of the collaborative planning model proved invaluable in the implementation of the practicum strategies.

b. Record Of Action

The sequence of events to implement this study began in August 1986 when the writers met with the general director of Elementary Education to discuss interest and concerns raised by the writers relative to the area of thinking skills. Under the direction of the director of Elementary Education, a district task force was then appointed. At the same time, the writers were given approval to form study teams in the two schools selected. Both groups proved to be essential elements in the practicum implementation.

In September, the initial meeting of the district Critical Thinking Skills (CTS) task force was held. The purpose of the task force was to develop a district model(s) for teaching critical thinking skills to elementary students. The task force identified the following goal and objectives:

Goal: Work as a group to identify dimensions and strategies for teaching thinking using research and literature, and to propose models or strategies for promoting the development of thinking skills for all elementary students.

Objective 1 Conduct a review of the literature and submit a final report by May 1987.

Objective 2 By November, develop a list of visitation sites, consultants and conferences scheduled for the 1986-87 school year.

Objective 3 Establish study teams to field test, review, and make recommendations on most promising strategies or models to the committee by February 1987.

Objective 4 Develop a systematic way to review and report strategies and models involved in the study by November 1986.

Objective 5 Prepare a position paper identifying the most promising strategies for implementation in the district and propose a model(s) for training elementary instructional personnel by May 1987.

Each writer met with the principal and CIS of the selected schools and identified the teachers who participated on their respective study team. A team leader was identified in each study team. The writers then scheduled the initial meeting with their study teams. Other activities of the writers included developing the teacher and administrator survey and the classroom-observation instrument. The writers selected an observer and provided training and a practice session in the use of the observation instrument. In addition, the writers submitted a proposal to the Florida Education Research Council (FERC) for additional funds to support the practicum implementation.

In October, each writer held an initial meeting with their study team. The meetings were held separately, but the writers developed a basic agenda to be followed with each group. The study teams were involved in several brainstorming activities for the purpose of stimulating thinking. Participants were then asked to brainstorm the concept of "thinking" and, using a Delphi Dialogue Technique, the writers listed group ideas, wrote responses, clustered responses, and labeled ideas. The writers asked their respective study teams to respond to a self-reflection survey regarding thinking and the teaching of thinking skills. The district CTS task-force goal and objectives were shared with the study team. Each study team, under the direction of the writers, addressed the district's Objective 3 and developed their own action plan. The writers discussed the role of the study team, the practicum implementation plan, and the tasks to be addressed by the study teams. The participants on the study team were volunteers who had expressed interest in the area of thinking. Meetings were held after school hours and participants were paid $200 (per teacher) and $300 (team leader) respectively.

Several handouts were used by the writers to guide the study teams through an orientation to thinking and higher-order thinking and questioning skills. In addition, participants were given "An Incomplete Bibliography" on the study of thinking and a listing of materials and resources on the teaching of thinking that were available in the district. Participants in each study team viewed *Teaching Skillful Thinking*, a four-part, video-based, staff-development program, developed by the Association for Supervision and Curriculum Development (ASCD). The series includes: "Issues in Teaching Thinking," "The Skillful Thinker," "Teaching For Thinking," and "Teaching Of And About Thinking."

Each participating classroom teacher on the study team was observed for a minimum of thirty minutes in October 1986. The instrument used for the observation was developed by the writers. The observer was a former elementary supervisor who had recently retired. Participants knew of the observation and were familiar with the observation instrument. Following the observations, the writers met with the study teams to discuss general concerns and comments noted on the instruments by the observer.

The study teams met on their own once a week under the direction of the team leader. The writers met with the study teams once a month in November, December, January, February and March. The purpose of these meetings was to allow the study teams to share ideas, concepts, information, programs and materials, etc., regarding their study of thinking with the writers. The writers served as facilitators and disseminators of literature and materials for the study teams, as well as active participants in discussions regarding thinking skills and the teaching of thinking that were raised by the participants. The writers informed the study teams of the activities of the district CTS task force and responded to questions and concerns of the participants.

In November, the writers met with the district CTS task force. The purpose of the meeting was to hear progress reports from task force members, to review the district action plan, to identify review criteria and to develop a reporting form for reporting on strategies and models used to teach thinking. Reports by task force members indicated that tasks were being completed as planned. It was decided at this meeting that a specific set of criteria for comparing models and strategies was not necessary and may be prohibitive to the study teams in their final analysis of a strategy if they were asked to only look at those things cited.

The January meeting with the district CTS task force included progress reports by members, a review of timelines, and members viewed the first two of the ASCD videos from the *Teaching Skillful Thinking* series. A discussion followed the video viewing. The task force also developed a proposed budget for anticipated inservice training needed in the area of teaching thinking for the following school year.

The writers met with the study teams in March to provide direction and support as they wrote their report and recommendations to be presented to the district CTS task force at the end of the month. Scheduling conflicts caused the timeline to be adjusted, and the study teams were not able to report to the CTS task force until April 10, 1987.

In April, the reports and recommendations from the study teams were presented to members of the district CTS task force. Under the direction of the writers, each study team worked to review, field test, and make recommendations to the task force concerning the most promising strategies for teaching critical thinking.

School B's study team adopted the following purpose for a critical-thinking-skills program:

> A critical-thinking-skills program in the Hillsborough County schools should be to expand and maximize each student's independent thinking and reasoning ability.

This study group concluded that critical thinking skills should be promoted at all grade levels and in all subject areas using the existing curriculum. Accordingly, teachers would need to employ different teaching strategies and questioning techniques that would encourage students to use higher-level thinking skills. A complete copy of the final report is available upon request.

School A's study team concluded that time was needed to allow teachers to teach critical thinking skills and then provide for application and practice of those thinking skills within all subject areas. The study team also concurred that critical thinking should be offered to *all* students in K-6 and not be limited to any particular group of children. A complete copy of this final report is also available upon request.

Following the reports from the two study teams, the district CTS task force met in April to discuss the reports and to develop an outline to be used by the task force members in writing the district report. The discussion led participants of the task force in many directions and caused such questions as follows to arise: How do we make change in schools? How do we get change to come from within? How can we get schools/teachers to see critical thinking skills as a need? What about the PROCESS of critical thinking? What about metacognition and reflective thinking time? What thinking skill(s) does the

district value? Where do these thinking skills occur in existing materials? Are thinking skills broader than questioning skills? When we teach thinking, what are we teaching?

Following the lengthy discussion, the task force compared the two reports by listing the commonalities and differences in them. The commonalities included:

* there is a need to address critical thinking
* all students should be involved
* total school commitment is required
* there is a need to know more about critical thinking skills
* the knowledge base for teaching critical thinking skills is limited
* teacher training should occur prior to implementation
* training materials, such as ASCD video tapes are required
* a monitoring/evaluation system is needed

The differences included:

* different approaches were advocated, i.e., integrated vs. separate subject
* effects on allocated time — the separate subject approach requires additional time, the integrated approach does not
* one group focused on research, the other on program materials
* county monitoring was advocated by one group, in-school coaching by the other

The task force then developed a plan for writing the district report. Phase I included the goal of the study, procedures used, study-group reports, analysis of the reports and recommendations. A complete copy of the *Critical Thinking Skills Task Force Phase I Report* is available upon request. The results and conclusions of the study reported that the focus on critical thinking skills was productive. There were still many questions to be addressed, but the foundation for future study by the district was firmly established. Among the recommendations made was that the elementary staff be involved in a summer study of critical thinking. As a result, a seminar was planned that provided an overview of the area of critical thinking skills.

The classroom teachers in the study teams were observed for a minimum of thirty minutes again in April/May. Results of those observations indicated that significant change had occurred in the teachers' use of higher-order questioning and students' use of higher-order thinking over the initial observation in October. Participants were again asked to respond to the self-reflection survey regarding thinking and the teaching of thinking skills.

In May 1987, the *Critical Thinking Skills Task Force Phase I Report* was shared with the Elementary Instructional Staff. Following a lengthy discussion of the report, it was agreed that the recommendations to involve the elementary staff in a summer study of critical thinking skills should be carried out. The writers were responsible for planning and conducting that seminar, with the assistance of members of the district CTS task force. The seminar was designed to familiarize the elementary staff with critical-thinking-skills materials, to develop the knowledge base to plan for a more in-depth study in critical thinking, and to provide a forum for the staff to discuss strategies for placing increased emphasis on critical thinking skills for all students. Staff members were given several handouts to guide them through their study on critical thinking skills. In addition to a calendar of events and specific articles to read and respond to by answering study questions, the staff was given the following set of questions to consider and respond to at the first meeting held in June:

1. What are critical thinking skills?
2. Who are some of the major writers, researchers in the area of critical thinking?
3. What are the main philosophical conflicts within the field of critical thinking? How might this conflict affect our decisions in the district?
4. How is your area of responsibility addressing critical thinking at this time? Do you see overlap with other areas? How?
5. What, in your opinion, is the current status of critical thinking instruction in the district? How important is the instruction of critical thinking skills?
6. What strategies seem the most promising for dealing with the area of critical thinking?

The summer seminar for the elementary staff was well received. Staff members found themselves attempting to develop a common language of what critical thinking is and to determine what we want to do as a district that deals with the teaching of thinking. The staff recommended that the lead had to come from within the instructional division, there was a need to continue to learn about thinking and the teaching of critical thinking skills, and speakers needed to be brought into the district to make presentations regarding the whole area of thinking. The next meeting of the elementary staff to discuss CTS was scheduled for September 1987.

Chapter 5

EVALUATION

a. Measurement

Two instruments were used in the study to collect process data. An observation instrument based on Bloom's Taxonomy was used to collect data on student higher-level thinking skills and teacher higher-level questioning skills (Appendix A, pages 42-43). An Attitude/Awareness Survey, developed by the writers, was used to obtain perceptual data from the teachers and administrators involved in the school-based study teams (Appendix A, pages 44-45). The survey was adapted from checklists found in the book, *Developing Minds.*

The observation instrument divided thinking skills into lower-level thinking skills and higher-level thinking skills. As categorized by Bloom, lower-level skills are knowing and comprehending, and higher-level skills are analyzing, synthesizing, and evaluating. Based on the Department of Testing and Evaluation's previous experience with the instrument in the Academically Gifted Program, the writers elected to group the skills for purposes of observation into higher- and lower-level skills, but difficult and time-consuming to decide whether the behavior was, for example, an analysis, a synthesis, or an evaluation behavior. Questions were also characterized by the level of thinking skill they would elicit. Sample questions were developed to help the observer key the information as follows:

Lower Level — What do we know about magnets?
What was angle ABC?
Who were the characters in the story?

Higher Level — How can you prove that?
How shall we graph that information?
If you lived in Kansas, what would the weather be like?
Is this the only possible answer?
Do you have an idea why the data is different?
Are these two specimens similar?

Samples of student thinking were given to the observer to help record responses in the appropriate category. Some of these are as follows:

Lower Level — Recalling facts.
Tallahassee is the capital of Florida.
Birds have feathers.
5 and 10 = 15

Higher Level — Giving the main idea of a story.
Giving reasons an experiment didn't work.
Drawing conclusions based on data.
Giving an interpretation of an event or story.
Comparing one thing to another.
Formulating a hypothesis.
Identifying criteria for determining the quality of something.

Procedurally, the writers met with the observer to review the observation instrument and determine how to make recordings during a thirty-minute period. The observer then conducted one observation and consulted again with the writers to confirm the use of the instrument and report any difficulties in making entries. Following this validation step, the observer was scheduled to observe each teacher involved in the study. Teachers were notified in writing ten days prior to the scheduled observation. Observations were conducted once in October and again in April for each teacher.

After all evaluation activities were completed with both instruments, the writers tallied and summarized the results for inclusion in this report. Observation tallies were counted for each thirty-minute period to determine the percentage of responses devoted to higher- and lower-level thinking skills and the percentage of questions noted as higher- or lower-level questions. In addition to inclusion in the practicum, the results were included in the District Task Force's Report on CTS.

b. Criteria of Success

Objective 1:

As indicated by the data in Table 1 and Table 2, all but one of the teachers involved in the study showed an increase in the use of higher-level questions. From the observers' notes, the teacher that showed a decrease was reading a story to the class and, for most of the time, children just listened. The observer also noted that many teachers

used a technique of probing or expanding on a question or a student's response. This technique was observed in all but a few of the teachers' classrooms.

After tabulating the results for all of the teachers, an increase of 22 percent was noted for the teacher's use of higher-level questions within the classroom (Table 3). This increase exceeded by 2 percent the 20-percent level of success criteria the writers had established for this objective.

Table 1

Teacher Higher- and Lower-Level Questions
Percent in one Class Period
School A 1986-87

Teacher	Higher Level		Lower Level	
	Oct	April	Oct	April
1	57	69	43	31
2	65	50	35	50
3	10	47	90	53
4	19	25	81	75
5	21	67	79	33

Table 2

Teacher Higher- and Lower-Level Questions
Percent in one Class Period
School B 1986-87

Teacher	Higher Level		Lower Level	
	Oct	April	Oct	April
1	11	69	89	31
2	30	82	70	18
3	33	48	67	52
4	31	54	69	46
5	23	14	77	86
6	42	67	58	33
7	65	79	35	21

Table 3

Teacher Higher-Level Questions
Average Response in One Class
Period 1986-87

School	Teachers (N)	Oct	April	% Change
School B	7	34	59	25
School A	5	34	52	18
Total	12	34	56	22

Sample questions recorded by the observer indicated that teachers used an assortment of questions. These questions required the students to analyze, synthesize or evaluate. Examples of the questions teachers used are as follows:

Math

First Grade - If you run out of space on your paper, what do you need to do?

Second Grade - Why did you think that answer was incorrect?
Why did you select that process?
What helped you decide on that answer?

Science

Kindergarten - Which of these animals would make good pets?
Imagine that you are a wild animal, what are you going to have to protect yourself? What will you look like?

First Grade - How is the mealworm like the insect we looked at yesterday?

Third Grade - Why do you think the balled-up paper went farther than the flat piece of paper?
What do you picture in your brain when you hear the term "chain reaction"?
What unit of measure could we use to find the rate of our heart beat?
How many ways could you group students in this class?

Fourth Grade - Why would you need to have a narrow field of vision to dissect a frog?

Fifth Grade - What might you do to instill trust in the community when you build the skyway bridge?

Reading

Third Grade - How would you describe what it is like to be doubtful?

Fourth Grade - How was Katherine's life different from yours? What would happen if you were suddenly put back 100 years?
How can we categorize what we know about the olympics?

Writing

Fifth Grade - If you could use just two or three words to describe the scene, what would they be?

Objective 2:

As indicated by the data in Table 4 and Table 5, students in all but two teachers' classes showed an increase in the use of higher-level thinking skills within the classroom. As was the case in the use of questioning skills, one teacher read a story and did not ask many questions that required the use of higher-level thinking by the students. In the other exception, the students used higher-level thinking skills 63 percent of the time in October. In April, they were reported to use higher-level thinking skills 53 percent of the time. This was in a gifted classroom with a teacher who had received training in CTS during the 1985-86 school year. Therefore, even though there was a decrease, the majority of student time was spent using high-level thinking skills.

After tabulating the data for all classes, the average percent of increase was 24 percent (Table 6). This exceeded by 4 percent the 20-percent level of success criteria established by the writers at the beginning of the study.

Table 4

Student Higher- and Lower-Level Thinking Skills-Percent of Response in a Class Period School A 1986-87

Teacher	Higher		Lower	
	Oct	April	Oct	April
1	57	58	43	42
2	65	86	35	14
3	0	42	100	58
4	19	80	81	20
5	24	76	76	24

Table 5

Student Higher- and Lower-Level Thinking Skills - Percent of Response in a Class Period School B 1986-87

Teacher	Higher		Lower	
	Oct	April	Oct	April
1	8	35	92	65
2	30	56	70	44
3	33	56	67	44
4	31	14	69	86
5	23	67	77	33
6	42	56	58	44
7	63	53	37	47

Table 6

Student Higher-Level Thinking Skills
Average Percent of Response in a Class
Period 1986-87

School	No. Teachers	Oct	April	% Change
School B	7	33	48	15
School A	5	33	68	35
Total	12	33	57	24

The results also showed that the students increased the use of higher-level thinking skills from one-third of class time to a little over half of class time. The observer reported that students built on other students' answers, felt secure in clarifying statements, and used logical thinking to solve problems. According to the observer, the students evidenced the ability to interpret graphs and tables, to make deductions and to draw appropriate conclusions.

Objective 3:

All of the teachers showed an increase in their awareness of CTS (Table 7). Even though the average gain reported by the data was only 6 points, the writers noted considerable change in awareness throughout the year. The teachers remarked in discussion groups and planning sessions that they had learned about and become much more aware of CTS. The gain in Attitude/Awareness exceeds the level of success criteria established by the writers. The initial goal was to have 90 percent of the teachers show an increased awareness of CTS.

Table 7

Thinking Skills: Teacher Attitude/Awareness Survey 1986-87

Teacher	Number of Items 14 October Survey	Possible Score (14-70) May Survey
1	57	65
2	45	51
3	55	58
4	52	65
5	58	62
6	52	54
7	44	46
8	49	53
9	51	62
10	58	59
11	54	61
Average	52	58

c. Side Effects

The writers noted several positive effects that occurred as a result of the study. These observations by the writers are as follows:

Teachers exhibited an openness and willingness to learn and be involved in the study. They were very willing to be observed in the classroom and to spend extra time required in completing their study of CTS.

Participants exhibited a high energy level for learning about CTS. Participants were very interested in what the direction of the district should be in regard to CTS. As a result of their involvement in the study and the level of responsibility given to them, the members of each study team demonstrated a high degree of ownership for their recommendations submitted to the District Task Force.

Teachers, administrators and supervisors in each setting developed strong support networks.

Skills learned in the study teams by the participants were used for other tasks. One Curriculum Intervention Specialist (CIS) reported using the goal-setting strategies with the faculty to formulate school reading goals requested by the superintendent.

A bibliography of literature and reference materials related to CTS was compiled and is added to as new material becomes available. This material is accessible to all supervisors and school sites.

As a result of interest in CTS, the Elementary Education staff planned a summer seminar on CTS. The writers served as workshop leaders for the seminar.

In the classrooms, students and teachers exhibited a more relaxed attitude to accommodate discussion, dialogue, and student inquiry.

d. Effectiveness of the Management Process

The writers were members of a School Effectiveness League that was made up of supervisors and elementary school principals. This league met throughout the year and received training in Managing Productive Schools (MPS). The authors of the MPS model, Dr. Karolyn Snyder and Robert L. Anderson, were the trainers for the league. Two of the members of this group served as observers for the study. At each training/coaching session, the writers reported on progress with the study and received coaching and guidance on working with the groups. This process continued from August through June.

The development of Action Plans by the study teams and the District Task Force helped the writers maintain quality control over the study. Each Action Plan identified key events, a time line for completion, the individual(s) responsible and resources to accomplish the task. At each meeting with the groups, the writers used the Action Plans to monitor progress; completed tasks were dated and unfinished tasks were reviewed to ensure they would be completed on

time. The power of this technique originates with the internal control factors of the group (ownership), instead of external control factors normally associated with assigned tasks. The groups had originated the plans and wanted to make sure they followed through on their commitment. Added to that was the quality of work produced and the pride exhibited in their accomplishment.

The final measure of effectiveness was the quality of work produced by the study teams and the District Task Force. Each study team developed a position paper to help in the formulation of a long-range plan to improve CTS within the district. The plans were comprehensive and included many helpful recommendations to assist the district in furthering its plans for improving CTS.

Throughout the year the writers met on a regular basis to check the progress of the study and discuss the effectiveness of the implemented strategies. Because the groups were so effective in carrying out their responsibilities, very few changes had to be made. In one instance because of schedule conflicts, the final report meeting had to be rescheduled; no one wanted to miss the presentation.

Finally, based on having exceeded each of the targets established for objectives 1-3, the writers conclude the management process was effective.

Chapter 6

Decision on Future

a. Maintain, Modify, Abandon

The implementation plan for developing a long-range plan to improve higher-level thinking skills in Hillsborough County was expanded and will continue into the 1987-88 school year. The response of the elementary instructional staff to the District Task Force Report led to the recommendation that a summer seminar be developed to familiarize the elementary staff with critical-thinking-skills materials, develop a knowledge base to plan for a more in-depth study in critical thinking, and to provide a forum for discussion of strategies for placing emphasis on critical thinking for all students. At the conclusion of the seminar, held in June, a September meeting was scheduled. At the meeting in September the staff will identify specific strategies they can use to promote critical thinking and will develop an implementation plan to carry out the strategies.

The success of the study can be seen in the amount of interest and concern that was generated by the study relative to the area of thinking and the teaching of critical thinking skills. In both study-team reports, there were many commonalities, but the dominant thoughts were that there was a need to address critical thinking, the knowledge base for teaching critical thinking is limited, and that all students should be included. Teacher, principal, supervisor and CIS awareness of critical thinking was enhanced by the study. Teachers participating in the study showed an increased use of higher-level thinking skills in the classroom.

The collaborative model used in the study was successful for identifying goals, designing action plans, and empowering individuals to contribute in a meaningful way to the success of the group. This model should be used in the expansion of the study of critical thinking.

The generated lists of consultants for thinking skills and the schedule of conferences focusing on critical thinking were helpful and should be maintained. Budget constraints in the district prohibited any member of the study group from attending a conference during the implementation year. In the future, such may not be the case.

As educators begin to address critical thinking skills there will be a need to find or develop instruments to measure gains in thinking. To

date, existing tests do not measure one's ability to think or measure the processes involved in thinking. If there is a need to measure the effects of training and teaching, new instruments will be essential.

The surveys used to determine administrator and teacher reflections on thinking and the teaching of thinking may need to be modified in some way. In some cases there was a drop in scores from pre- to post-test, but it was difficult to determine if the drop indicated a loss of knowledge and/or skill or a change in perception towards thinking following an in-depth study on the topic.

Based on the experiences and information gathered from the study, formation of new study teams would be of benefit to the development of thinking. As participants became more involved in the study, they began to realize how little they really knew about the teaching of thinking and what a complex task critical thinking skills are. The result was a change in teaching behavior and style. There is something to be said for discovery learning.

b. Benefits to Consider for Dissemination

As was previously stated, the program will be continued in the 1987-88 school year. The two study teams will not be re-established, but perhaps others will be formed in their place. The writers believe that educational leaders could benefit from the experiences gained as a result of this practicum. Some of these benefits include:

* Use of the MPS collaborative model for identifying goals and developing action plans allowed participants to feel ownership in the project. The model also allowed all levels of personnel to work together toward a common goal.

* Awareness of CTS and teaching thinking was heightened in the district. As participants learned about thinking and thinking skills, their use of that knowledge carried over into the classroom.

* Although the initial intent of this study was to identify strategies for teaching thinking that could become the basis for developing inservice training for teachers in the district was not met, awareness of the need for teaching thinking skills at the elementary level to all students became evident to each participant involved in the study.

c. Conclusions and Recommendations

In conclusion, the writers attribute the success of this study, "Developing a Long Range Plan to Improve Higher Level Thinking Skills," to the cooperation of the elementary instructional staff, the members of the district task force and the study team members. With their enthusiasm, dedication and support, the writers had the opportunity to implement the study-intervention strategies.

The writers also consider the recommendations made in the *Critical Thinking Skills Task Force Phase I Report*, May 1987, significant in relation to the study. Those recommendations for continued study of CTS in the district are as follows:

* Involve the elementary staff in a summer study of CTS.

* Support teachers and faculties that want to learn more about the area of CTS with available resources and materials.

* Continue to review commercial programs to determine their potential use in Hillsborough County.

* Identify the thinking skills to be emphasized in the district and the subject areas in which they can best be taught.

* Following participation in the summer seminar on CTS, have the elementary staff plan additional professional activities for the remainder of the school year.

* Consider having each school develop an improvement goal for critical thinking.

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Appendix A

Hillsborough County Public Schools
Thinking Skills Task Force
Observation Instrument 1986-87

Grade level _____
Date _____ Time _____

Variable Ratings By Sample Point

0-15 minutes	15-30 minutes
Content Area: _____	Content Area: _____
# Groups: WC___ L___ S___ L___	# Groups: WC___ L___ S___ L___
# Students/Group: _____	# Students/Group: _____
Delivery Technique _____ (Lec, Dis, Ind Act, Tea Dir, Other)	Delivery Technique _____
Thinking Skills Lower: _____ (Knowledge, Comprehension)	Thinking Skills Lower: _____
Thinking Skills Higher: _____ (Application, Analysis, Evaluation, Synthesis)	Thinking Skills Higher: _____
Questioning Lower: _____	Questioning Lower: _____
Questioning Higher: _____	Questioning Higher: _____
On-Task Behavior: _____	On-Task Behavior: _____
Teacher/Student Interaction _____	Teacher/Student Interaction _____
Student/Student Interaction _____	Student/Student Interaction _____

Examples of Questions: _____

Examples of Responses/Interaction: _____

Hillsborough County Public Schools

OBSERVATION SYSTEM 1985-86

On-Task Categories

1 = No students on-task
2 = Few students on-task
3 = Some students on task
4 = Most students on-task
5 = All students on-task

Teacher-Student Interaction

0 = No teacher-student verbal communication
1 = Teacher lectures; students listen
2 = Teacher lectures; students occasionally question and/or respond
3 = Teacher lectures; students frequently question and/or respond
4 = Discussion/dialogue between teachers and students
5 = Mostly student talk; occasional comment
6 = Other

Student-Student Interaction (academically-related)

0 = No student-student verbal communication
1 = Little student-student verbal communication
2 = Occasional student-student verbal communication
3 = Frequent student-student verbal communication
4 = Other

TEACHER SELF-REFLECTION CHECKLIST

Using a scale of 1 to 5, rate your classroom according to the following items.

5 = Very Often 4 = Often 3 = Sometimes 2 = Seldom 1 = Hardly Ever

1. When students pose unusual or divergent questions, I ask, "What made you think of that?	5	4	3	2	1
2 Whatever the text says is accepted as the right answer.	5	4	3	2	1
3. When a decision has to be made between involving the class in a discussion of an intriguing student idea (topic related) or moving on to "cover" content, I choose the latter.	5	4	3	2	1
4. I encourage students to seek alternative answers.	5	4	3	2	1
5. Students give reasons for making statements.	5	4	3	2	1
6. I use subject matter as a means for students to generate their own questions (or problems), which we then seriously consider.	5	4	3	2	1
7. When teaching, I sit or stand behind my desk.	5	4	3	2	1
8. Most questions posed during class can be answered with short or one-word answers.	5	4	3	2	1
9. Students spontaneously engage in critiquing each other's thinking.	5	4	3	2	1
10. Students relate subject matter to experiences in other subjects or in their personal lives.	5	4	3	2	1
11. Students often set objectives for their own learning.	5	4	3	2	1
12. Students spend time working collaboratively to solve subject matter questions.	5	4	3	2	1
13. One focus in my classroom is trying to understand how and why people (mentioned in texts) created ideas, solutions, experiments, rules, principals, and so on.	5	4	3	2	1
14. Students actively listen to each other.	5	4	3	2	1

ADMINISTRATOR/CIS SELF-REFLECTION CHECKLIST

Using the following questions as your criteria, rate your school's effectiveness in developing thinking skills.

Degree of Effectiveness: 5 = High 1 = Low

1.	Do your community and staff value thinking as a primary goal of education?	5 4 3 2 1
2.	Does the staff believe that with appropriate intervention human intelligence can continue to grow throughout life?	5 4 3 2 1
3.	Have you reached consensus on or adopted a model of intellectual functioning?	5 4 3 2 1
4.	Are students aware that intelligent behavior is an instructional objective?	5 4 3 2 1
5.	Does the teachers' language (questioning and structuring) invite students to think?	5 4 3 2 1
6.	Do the teachers' response behaviors extend and maintain higher levels of thinking?	5 4 3 2 1
7.	Are learning activities arranged in order of increasing complexity and abstraction?	5 4 3 2 1
8.	Do instructional materials support higher cognitive functioning?	5 4 3 2 1
9.	Is adequate instructional time devoted to thinking?	5 4 3 2 1
10.	Does instruction provide for differences in modality strengths?	5 4 3 2 1
11.	Are concepts and problem-solving strategies encountered repeatedly throughout, across, and outside the curriculum?	5 4 3 2 1
12.	Do students and teachers discuss their thinking (metacognition)?	5 4 3 2 1
13.	Do evaluation measures assess intelligent behaviors?	5 4 3 2 1
14.	Do significant adults model intelligent behaviors?	5 4 3 2 1

Appendix B

EXTENDING STUDENTS' THINKING

Extending students' skills in complex thinking, as well as developing their ability to apply that thinking process to the creative solution of problems, has become an important goal of education. In spite of educators' dedication to this goal, many school assignments involve only recalling information and being tested for knowledge of facts (names, dates, number facts, etc.). Having information is important, but the students need the opportunity, as well as the responsibility for using that information in life situations and in creative ways. Several years ago, Dr. Benjamin Bloom of the University of Chicago developed a taxonomy or classification system of the cognitive domain in order to identify the levels of thinking demanded of students. This classification system makes it possible to deliberately develop school assignments and independent activities that enable students to practice extending their information into higher and more creative levels of thinking.

Bloom's six levels of cognitive (thinking), greatly simplified are:

1. Knowledge: Recall or location of information. This is the most common type of classroom assignment. An example of this level of thinking is the factual question (What did Columbus do? How much is 5 x 25? What happened in the story?). The information is remembered or the answer to the question can be located and does not need to be interpreted or inferred. Activities at this level provide the student with information which he can use to generate more complex thinking. There is nothing wrong with teaching facts, they are essential to all higher levels of thinking. But don't stop there, enable students to use those facts in more elaborate or creative ways.
2. Comprehension or Understanding. This level of thinking requires that students understand the facts they are learning, not merely recall or parrot information. "Why" and "how" questions may test understanding providing the student explains in his own words and doesn't merely repeat something he has read or heard. "Give an example" or "Say it in a different way" are ways of checking a student's understanding.

Examples of activities which require understanding are:

a. Draw a picture that would go with the beginning of the story, one that would show what happened in the middle of the story and one that happened at the end.
b. Give an example of something the boy did that showed he was dependable.
c. Explain what you are doing while you are working the problem.
d. How do you think the boy in the story felt (providing it doesn't tell this in the story)?

These first two levels of thinking, possession of information and understanding that information, constitute the foundation on which all complex thinking is built. A learner cannot do creative or high-level thinking without this foundation. (It is impossible to make judgments about democracy and socialism unless there is understanding of what each is.) Again, the important function of teaching is to start with the foundation, but encourage the student to build on his understanding and extend his thinking.

3. Application. The third level of cognition is the beginning of creative thinking. Application includes activities where the student applies what he has learned to a situation which is new to him rather than one where he remembers the answers.

   Examples of application activities are:

   a. Solve word problems in math.
   b. Apply a generalization or principal to a new situation. Examples: "Which of these imaginary animals could live in intense cold?" (Assuming that the student has learned that a warm-blooded animal has to have some protective covering.) "On this map, locate the most likely places for cities." (The student has to apply what he has learned about the location of cities such as: close to a major trade route, where water is accessible, etc.)
   c. What might Goldilocks do if she came to your house and you weren't home?
   d. If you treated him as you would like to be treated, what would you do?

The ability to apply what has been learned to a new situation is a very important goal in education for we cannot possibly provide practice in all the situations the student will encounter throughout life.

4. Analysis. The fourth level of cognition requires that the student "take apart" his information to examine or work with the different parts. This level of thinking requires the ability to categorize, which is man's unique intellectual technique to reduce the complexity of his world. The ability to perceive similarity in different things and difference in similar things requires the skill of analysis.

   Examples are:

   a. Tell five ways the boy in the story is the same as you and five ways he is different.
   b. List the words in the story that describe appearance and those that describe movement.
   c. What were the three main ideas of the story?
   d. How was Magellan the same as an astronaut? How was he different?

When students have to examine information and assign it to a prescribed category, they are operating at the level of analysis. A higher level of thinking is required if they have to create new categories in order to organize the information. Creation or invention of new categories constitutes synthesis or the fifth level of cognition. An analogy would be the determination of where material belonged and filing of that material in an organized filing system (analysis) or the creation of a new filing system in order to organize the material (synthesis).

5. Synthesis. This level of thinking requires that a student create or invent something: a generalization, picture, poem, story, organizational scheme, category, hypothesis. Synthesis requires the bringing together of more than one piece of information, idea, concept or set of skills.

   Examples of activities requiring synthesis are:

   a. A creative endeavor in the arts, a picture, a melody, an additional stanza or a new poem or dance, etc.
   b. Creating a story based on what might have happened if Red Riding Hood had met only a mouse in the forest.
   c. Writing an original story.
   d. Developing a hypothesis.
   e. Designing an experiment that would test that hypothesis.

6. Evaluation or Judgment. Judgments are made when clearly there is more than one possible point of view and the difference between a judgment and a guess is that the student can give reasons to support the judgment he makes. This is the highest level of thinking because in an evaluative judgment or opinion there is no right or wrong answer until you consider the evidence that is used to support that answer or conclusion. The person's judgment is considered valid when there is evidence to support it. A judgment should be supported by the answer to "why do you think so?" or "how can you tell?"

   Examples of activities on an evaluation or judgment level are:

   a. Which would have been more difficult, to be Daniel Boone or Columbus? Why do you think so?
   b. What should we serve at our party? Why?
   c. Under what conditions might a person be justified in not telling the truth? Why?
   d. Which solution is better? Why?

To ask learners to make judgments and support with data is to require thinking on the highest level of cognition. To ask less is to deny students the opportunity to practice becoming intelligent decision makers.

These six categories of thinking (knowledge, comprehension, application, analysis, synthesis and evaluation) provide a framework for designing appropriate activities to extend students' thinking. Remember, however, that students must have information which they understand before they can use it in new and creative ways. A student can't be creative until he acquired the skill or information necessary to that creativity.

It is not critical that you be able to identify or label the precise level of cognition for each learning activity. The important idea is to stimulate students to think beyond recalling and understanding information. Once these levels have been achieved, encourage students to use their information in problem solving and creative endeavors. Plan activities that require the student to identify similarities and differences, categorize information, speculate "what would happen if . . . ," compare and contrast others and themselves, create a new beginning or ending.

When you ask students to give an opinion or make a judgment about a person, situation or idea, have them cite the evidence which will support their judgment so it's not merely a haphazard guess or recall of something they have been told.

Make sure, however, that the student has the information necessary to do creative thinking. Do not ask him to give opinions about something he doesn't understand. Questions such as "Which is the better form of government?" "What do you think about this interracial crisis?" "What do you think about this political figure?" or other complex questions, may encourage him merely to parrot what he has learned from others when he does not have the information or understand it well enough to form his own "thinking opinion."

As you practice these activities for students, you'll be amazed and delighted to find how much you have extended your own thinking.

MODEL QUESTIONS AND KEY WORDS TO USE IN DEVELOPING QUESTIONS

Based on Bloom's Taxonomy, Developed & Expanded by John Maynara, Pomona, California

I. Knowledge (Eliciting factual answers, testing recall and recognition)

Who	Where	Describe	Which one
What	How	Define	What is the one best
Why	How much	Match	Choose
When	What does it mean	Select	Omit

II. Comprehension (Translating, interpreting, and extrapolating)

State in your own words	Classify	When are facts opinions
What does this mean	Judge	Is this the same as
Give an example	Infer	Select the best definition
Condense this paragraph	Show	What would happen if
State in one word	Indicate	Explain what is happening
What part doesn't fit	Tell	Explain what is meant
What restrictions would you add	Translate	Read the graph, table
What exceptions are there	Outline	This represents
Which is more probable	Summarize	Is it valid that
What are they saying	Select	Which statements support the main idea
What seems to be	Match	
What seems likely	Explain	Sing this song
	Represent	Show in a graph, table
	Demonstrate	

III. Applications (to situations that are new, unfamiliar, or have a new slang for students)

Predict what would happen if
Choose the best statements that apply
Select
Judge the effects
What would result
Explain
Identify the results of
Tell what would happen
Tell how, when, where, why
Tell how much change there would be

IV. Analysis (Breaking down into parts, forms)

Distinguish	What is the function of	What's the theme, main idea, subordinate idea
Identify	What is fact, opinion	What inconsistencies, fallacies
What assumptions	What statement is relevant, extraneous to, related to, not applicable	What literary form is used
What motive is there	What does author believe, assume	What persuasive technique
What conclusions	State the point of view of	What relationship between
Make a distinction	What ideas justify conclusion	
What is the premise	The least essential statements are	
What ideas apply, not apply		
Implicit in the statement is the idea of		

V. **Syntheses** (Combining elements into a pattern not clearly there before)

Write (according to the following limitations)

Create	How would you test	Make up
Tell	Propose an alternative	Compose
Make	Solve the following	Formulate a theory
Do	Plan	How else would you
Dance	Design	State a rule
Choose		Develop

VI. Evaluation (according to some set of criteria, and state why)

Appraise	What fallacies, consistencies, inconsistencies appear
Judge	Which is more important, moral, better, logical, valid,
Criticize	appropriate, inappropriate
Defend	Find the errors
Compare	

QUESTIONS OF CLARIFICATION AND STATEMENTS OF EXTENSION

There are several kinds of questions. Most often asked are those called closed. They can be answered "yes" or "no" and take little, if any, thought. Most students have, at some point, given a correct yes or no answer when they had no idea why they gave it or even if it was right. They know that they had a fifty-percent chance of being correct. That student would not be able to tell why they said what they did if called upon and hoped they would never have to explain. Seldom asked, at least in comparison, are Clarifying Questions: those questions that demand reasons or that tell why or how or where. Questions of Clarification can serve to explain, prove, and justify. They should be asked immediately upon hearing a closed response. "Why did you say that?" "What makes you think so?" and "Where else might we go to get that same information?" all serve to clarify a previously given answer. Along with Questions of Clarification come Statements of Extension. Often more information is needed and through the use of Extension Statements, appropriate and necessary information can be gained.

Most educators need hours of practice in asking Questions of Clarification and Statements of Extension. Several minutes during each class day should be spent on refining questioning ability. Listen for your closed questions and, when one has been asked, immediately stop and ask one that demands thinking and a complete answer. Get used to doing more questioning of what the students came knowing and less "teaching" through lecture and rote methods. Challenge yourself to go one full hour without asking a question that can be answered "yes" or "no". It seems impossible at first, but as you practice more, it becomes a realistic goal.

Following are two lists. The first is a listing of sample Questions of Clarification. Read the list over and then add several of your own. It is easy to use the same ones over and over, but you will find as you use this type of question more often that new ones will automatically come to you. Any who, what, why, when, or how question that demands a linguistically complete response, presents information for the purpose of clarifying, and adds to the learner/thinker's understanding is a

Question of Clarification. The second list is a series of Extension Statements. Again, read this list and then see how many more you can add. It is harder to gain variety with this type of statement, but there are many ways to get a child to add to what he has already said. Virtually anything asked that demands an answer other than yes or no, encourages the learner/thinker to extend a list, statement, thought, or idea, and aids in gaining more information related to the topic at hand is an Extension Statement.

CLARIFICATION - QUESTIONS AND STATEMENTS

Who told you that?
Who might we ask to tell us more . . . ?
Who could clear that up?
Who do you know that . . . ?
Who normally deals with . . . ?
Explain that.
How does that information add to . . . ?
How does your answer answer my question?
How might we use your answer to . . . ?
How do you know . . . ?
How can it help . . . ?
How does what you say relate to our subject?
How else can we say that?
Tell me what you mean by . . . .
Tell us why we should believe that.
Where can we use that?
Where might we go to find out?
Where could that be used?
Where might we implement that idea?
What reasoning did you go through to . . . ?
What does your answer have to do with my question?
What can we do to make it clearer?
What is another way we can say that?
What difference can that make?
What do you mean?
What good does it do to . . . ?

EXTENSION - STATEMENTS

Add on to that with an idea of your own.
Add more to what has been said.
Expand on your answer.
Extend on that.
Finish that list.
Give me one more.
Give two examples not already mentioned.
Give us more information on that.
Go on.
Help us out.
Keep it going.
Keep it rolling.
Take it one step further.
Name more.
Provide another example of.
Round out the listing by . . .
Stretch that out. Talk about it some more.
Take it from there.
Tell us one more to add to our list.
Tell us what you know about . . . .
Tell me another.
Continue with that.
Complete that idea.
Complete that thought.

WHY DO TEACHERS ASK STUDENTS QUESTIONS?

The whole sum of what may be said about questioning is comprised in this. It ought to set the learners thinking, to promote activity and energy on their part, and to arouse the whole mental faculty into action, instead of blindly cultivating the memory at the expense of the higher intellectual powers.

Why do teachers ask children questions? One of the most important reasons teachers ask questions is to find out what their pupils know and do not know. These questions are very valid, for they assist the teacher in planning and modifying his instructional program according to the needs of his class. He can avoid going over material the children already know or preventing material too difficult for their backgrounds. In a similar vein, by knowing the direction his children are going in a lesson, the teacher can redirect or focus by the questions he asks. Questions can be utilized for keeping the lesson relevant to the investigation at hand.

In addition to the above, teachers ask questions for these purposes:

1. To arouse interest — motivating children to actively participate in a lesson.
2. To evaluate a pupil's preparation and to see if his work or previous work has been mastered.
3. To review and summarize what is taught.
4. To develop insights by helping children see new relationships.
5. To stimulate critical thinking and development of questioning attitude.
6. To stimulate pupils to seek out additional knowledge on their own.
7. To evaluate the achievement of goals and objectives of lesson.

DEFINITION OF A GOOD QUESTION

Good questions are (1) clear, (2) purposeful, (3) brief, (4) natural and adapted to the level of the class, and (5) thought provoking.

1. Clear questions precisely describe points to which students are to respond. Vague questions can be responded to in many ways, and their ambiguous nature confuses students. Vague questions often result in wasted time as students ask the teacher to repeat or rephrase them. Questions can also be unclear if they are asked as part of an uninterrupted series.
2. Questions need to be purposeful; that is, they should lead toward clear achievement of the lesson's intent. Questions that are not planned in advance are seldom purposeful. Teachers who ask most of their questions "off the cuff" will ask many irrelevant and confusing questions that work against the achievement of their goals.
3. Questions should be brief. Long questions are often unclear. The longer the question is, the more difficult it is to understand.
4. Questions should be phrased in natural, simple language and should be adapted to the level of the class. If students do not understand, they cannot do what the teacher wants. Teachers need to be aware of student vocabulary levels as that, when they introduce new words, they can immediately clarify them and help students make the words their own.
5. Good questions are thought provoking. Questions or discussion sessions should force students to think about the facts they possess and to integrate and apply them. Stress the use of probing questions to help students clarify their ideas, and on the importance of conducting discussions that center on topics important to students so that they are motivated to share ideas and seek additional information.

MAKING EDUCATORS MORE EFFECTIVE QUESTIONERS

The following suggestions are presented for teachers who wish to start improving their own questioning skills:

1. Write down specific wording of 6-8 questions in your lesson plan before coming to class.
2. Ask your questions as simply, concisely, and directly as possible. Avoid such unnecessary introductions as, "What do you think about . . . ," "How many of you can tell me . . . ," etc.
3. Ask your questions before designating which child should answer. Pause briefly after asking the question so that all children have time to think about the question.
4. Ask an individual child to respond to your question. Total class shouting out of answers could result in classroom discipline problems for the teacher.
5. Ask questions of as many children as possible during the lessons . . . volunteers and non-volunteers, slow and bright, etc. Gear the difficulty to each child's interest, background, and ability.
6. Ask a question about the most obvious part of the investigation for your first question. Such a question might be, "How much weight did the hamster gain since last week?"
7. Ask as many questions that stimulate creative thinking processes as possible from among these categories:

   (a) comparison
   (b) summarization
   (c) observation
   (d) classification (grouping)
   (e) interpretation
   (f) criticism
   (g) making assumptions
   (h) collection and organization of data
   (i) evaluation

8. Ask questions that give children practical experience with process thought questions. These include:

   (a) designing an investigation - i.e., How would you find out?
   (b) hypothesizing or predicting - i.e., What do you think will happen?
   (c) making an operational definition - i.e., How would you define that?

9. Ask questions in a variety of ways in addition to "what," "how," "why," so that students are asked to:

   (a) illustrate or show how
   (b) explain
   (c) discuss
   (d) justify
   (e) trace
   (f) interpret
   (g) evaluate
   (h) contrast
   (i) summarize

10. Do not seek instant closure. Be willing to wait for an answer. (Hyman notes the positive results when teachers wait three to five seconds after asking a question or hearing a response.)
11. Always aim at getting the student to give some kind of response.
12. Do not answer your own questions, and do not imply an answer in your question. If you begin answering your own questions, students may wait for your answer, or may not answer it all.
13. Analyze questions carefully and sequence them according to difficulty.
14. Give students steps to follow in finding and verifying answers, and offer reinforcement of those steps.
15. Provide ample oral practice with different types of questions and then give students ample prompts until they are comfortable with question type.
16. Respond to the process a student uses, as well as the answer he or she gives.
17. Share strategies with content area teachers.
18. Ask reading-dependent questions. That is, ask questions which the reader will answer from knowledge gained from reading the material rather than from prior knowledge.
19. With more academically oriented pupils who generally become actively involved in discussions, concentrate on getting the correct response.
20. Prepare questions, questioning strategies, and questioning sequences ahead of time, and test them before making them a regular part of the lesson plan.

21. When preparing objectives and instructional guides, put the questions in question form rather than as suggestions for questions. This assures that the questions will be asked by the instructor at the appropriate cognitive levels. Also include anticipated answers and possible instructor-learner interaction patterns in lesson plans and guides.

QUESTIONS TO AVOID

1. Teachers are advised against excessive use of *yes-no questions*. Typically they are asked as warm-up questions. Yes-no questions confuse the lesson focus and waste time. Such questions encourage guessing because the students know they have a 50-percent chance of being right. Finally yes-no questions have a very low diagnostic value.

2. *Tugging questions* or statements often follow a partial or incomplete student response. Tugging questions essentially say to the student, "Tell me more." However, these questions are often vague and ineffective. When students are stuck for a response, they need a cue or some other kind of help. These questions provide no help. When students have responded to the initial question, teachers will be more likely to get additional information if they ask a new question.

3. *Guessing questions* require students to guess or reason about a question, either because they do not have the facts or because the question has no correct answer. Guessing questions can be useful for capturing students' imagination and involving them actively in discussions. However, if they are overused or used inappropriately, they encourage students to guess and respond thoughtlessly rather than think.

4. *Leading questions* and other rhetorical questions should be avoided. They reinforce student dependency upon the teacher. Questions should be asked only if the teacher really wants a response. Questions such as the following should be avoided. "Kathy, you want to read about the Pilgrims, don't you?" Avoidance of such rhetorical and meaningless questions help students develop the expectation that, when the teacher asks a question, something important and interesting is about to happen.

TOO MANY TEACHERS ASK POOR QUESTIONS

Educators often complain that students come to their classes not knowing how to answer a question properly. It is often observed that while many teachers are asking dull and trivial questions, they are hoping for stimulating, creative answers. Listen to yourself. Do most of your questions start with "Can you . . . ," "Who can . . . ," "Who will . . . ." If they do, there is little room for complaint when a student says, "No, I can't," drops down below desk level when you look his way to ask "Who can?" or refuses to answer a "Who will? . . ." type of question. Better than asking closed questions would be to demand answers. A closed question is any question that does not demand either a thoughtful answer or allows an answer of one word. Instead of thinking in terms of "questions," think in terms of statements. Statements such as "Tell me how . . . ," "Add one thing to . . . ," "Go on with what the author . . . ." These statements normally get at what was sought in the beginning, force the students to do some thinking, and put the responsibility for an answer on them. Also, the statement will force extended language usage and further language development. The statement is also much more positive than is a question. Whenever you ask "Can you . . . ," doubt is shown on your part. Maybe the student can and maybe the student cannot. The statement "Tell me . . . ," not only demands a response but tells the child that you know he can. If the child still cannot give an appropriate response, simply tell him to listen to other answers and that you will come back to him later.

MODELS USED IN DEVELOPING QUESTIONS

I. Convergent and divergent questions often accredited to as the Guilford Model or Robert Gagne's Discovery Model.

Convergent Questions:

Some questions cause children to move toward closure or to summarize and draw conclusions. They are called *convergent* questions. Recall questions fall into this category. "What is the color of this block?" is a convergent question. There is only one answer. Although their importance is limited, convergent questions are nevertheless necessary. Robert Gagne has cautioned that discovery could be undertaken only after the individual acquired a store of broad and critical knowledge. When convergent questions are overused, however, more advanced and creative thinking is inhibited. An excess of the question-answer, stimulus-response questioning can be destructive to developing process thinking in education. Convergent questions rarely lead to further investigation.

Divergent Questions:

Some questions, on the other hand, cause children to ask further questions, plan and carry out experiences with equipment, initiate projects, etc. These are called *divergent* or productive questions.

Divergent questions go further than convergent questions. They stimulate the learner to find out what is to be. The learner is encouraged to broaden or deepen the area to be studied. He is required to gather facts, evaluate them, and to engage in higher creative thinking processes in order to answer divergent questions. Because of their broadening effect, divergent questions are referred to as *open-ended* or *productive*.

II. A taxonomy of questions by Pearson and Johnson. Pearson and Johnson have adopted a question taxonomy with only three categories. They are:

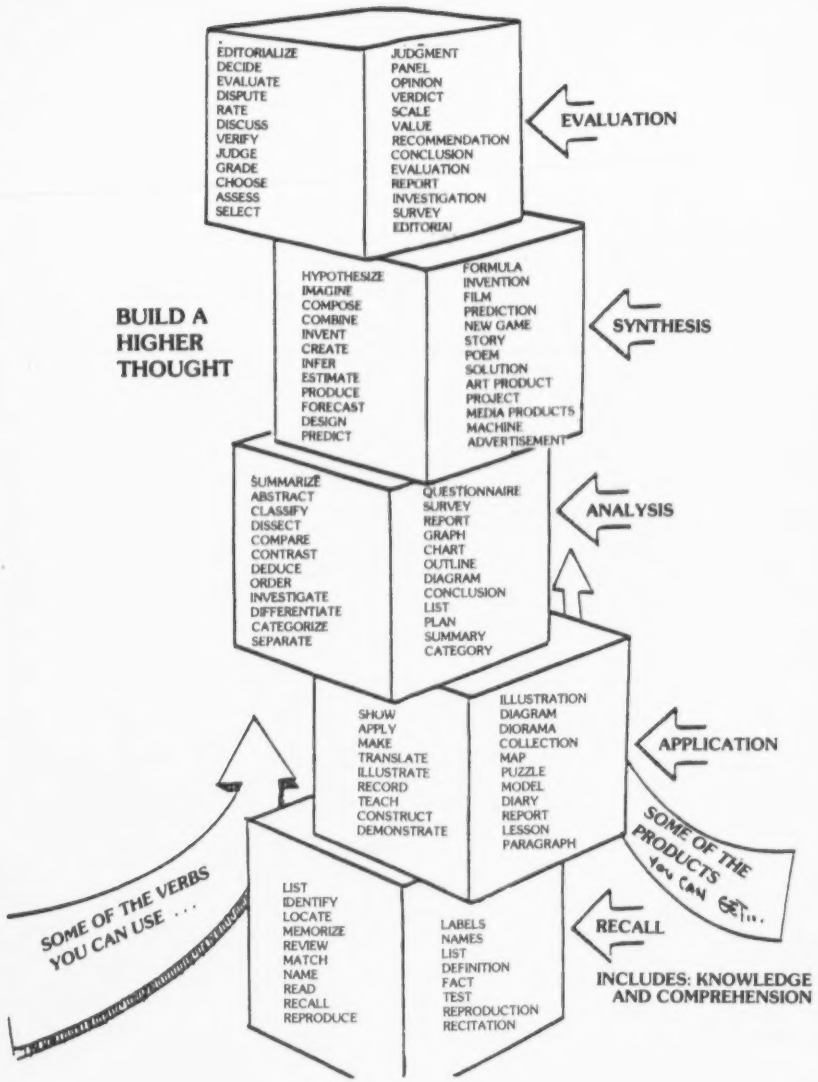
1. *Textually explicit* - these questions have obvious answers right off the printed page. Some would call them factual recall questions.

2. *Textually implicit* - these questions have answers that are on the printed page, but the answers are not so obvious. There seems to be some sort of inference necessary for these responses.

3. *Scripturally implicit* - these are questions that are related to the text (that is, there would be no reason to ask the question if the text were not there). The student's answer comes from prior knowledge if it is not there in the text.

III. The Hoover and Hollingsworth Model of questioning to develop critical thinking.

Recall	who what where when
Comprehension	how why
Analysis	assumptions motives identification implications
Evaluation	judgments personal reaction opinions criticisms


EDITORIALIZE
DECIDE
EVALUATE
DISPUTE
RATE
DISCUSS
VERIFY
JUDGE
GRADE
CHOOSE
ASSESS
SELECT
JUDGMENT
PANEL
OPINION
VERDICT
SCALE
VALUE
RECOMMENDATION
CONCLUSION
EVALUATION
REPORT
INVESTIGATION
SURVEY
EDITORIAL
EVALUATION
BUILD A HIGHER THOUGHT
HYPOTHESIZE
IMAGINE
COMPOSE
COMBINE
INVENT
CREATE
INFER
ESTIMATE
PRODUCE
FORECAST
DESIGN
PREDICT
FORMULA
INVENTION
FILM
PREDICTION
NEW GAME
STORY
POEM
SOLUTION
ART PRODUCT
PROJECT
MEDIA PRODUCTS
MACHINE
ADVERTISEMENT
SYNTHESIS
SUMMARIZE
ABSTRACT
CLASSIFY
DISSECT
COMPARE
CONTRAST
DEDUCE
ORDER
INVESTIGATE
DIFFERENTIATE
CATEGORIZE
SEPARATE
QUESTIONNAIRE
SURVEY
REPORT
GRAPH
CHART
OUTLINE
DIAGRAM
CONCLUSION
LIST
PLAN
SUMMARY
CATEGORY
ANALYSIS
SHOW
APPLY
MAKE
TRANSLATE
ILLUSTRATE
RECORD
TEACH
CONSTRUCT
DEMONSTRATE
ILLUSTRATION
DIAGRAM
DIORAMA
COLLECTION
MAP
PUZZLE
MODEL
DIARY
REPORT
LESSON
PARAGRAPH
APPLICATION
SOME OF THE PRODUCTS YOU CAN GET...
SOME OF THE VERBS YOU CAN USE ...
LIST
IDENTIFY
LOCATE
MEMORIZE
REVIEW
MATCH
NAME
READ
RECALL
REPRODUCE
LABELS
NAMES
LIST
DEFINITION
FACT
TEST
REPRODUCTION
RECITATION
RECALL
INCLUDES: KNOWLEDGE AND COMPREHENSION

GOOD QUESTIONING PROCEDURES

1. Questions should be planned.
2. Should be logical and sequential.
3. Questions should be directed to class.
4. Should allow students time to think.
5. Should be balanced between fact and thought.
6. Questions should be distributed widely.
7. Questions should be asked conversationally.
8. Questions should not be repeated.
9. The teacher should sometimes ask students to respond to classmates' answers.

1./
2. Points one and two are logical and appeal to common sense.
3. Teachers should get better attention if they do not call on a student until after they ask the questions.
4. The suggested pattern is, ask the question, delay and allow students time to think (a five-second pause is most often recommended).
5. Students of all levels are likely to learn more when fact and thought questions are organized in sequences to emphasize key points and lead to goals.
6. Most students benefit from opportunities to practice oral communication skills, and distributing response opportunities helps keep students attentive and accountable.
7. Questions that are interesting which challenge friendly exchanges of information are likely to generate maximum motivation and produce the most regarding answers.
8. Teachers who continually repeat and rephrase their questions teach students that they need not pay attention. This also is a sign of poor preparation or disorganized thinking.
9. Allowing students to respond to one another is helpful for demonstrating teacher interest in obtaining student discussion. Research shows students make higher grades, particularly in the science and social studies areas.

CAN CRITICAL THINKING BE TAUGHT IN A VACUUM?

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There recently has been an explosion of interest in the venerable construct of critical thinking. One manifestation of this bandwagon is a modest polemic between Adler (Sept. 17, 1986) who asserted that critical thinking could not be taught in a content vacuum. He was responded to by Sternberg (Oct. 15, 1986) who asserted that Adler had incorrectly characterized the current critical-thinking instruction programs as being divorced from content.

This article reports and assesses the evidence on both sides of this issue.

Inductive Evidence

The following articles represent inductive evidence that thinking skills in general and critical thinking skills in particular cannot be taught in a vacuum.

In a study of logical thinking research on Piaget's formal operational theory, Lawson, Karplus and Adi (1978) concluded that formal reasoning should be taught through interdisciplinary programs from widely differing content areas. In other words, logical thinking should be taught through a broadly based curriculum inferentially predicted on a necessarily broad array of vocabulary and concepts, not through some quick, short, and inexpensive treatment.

Linn (1982) reviewed the literature on the attempts to teach reasoning ability in math and science-related problems, and concluded that they have met with limited success. She also noted that teaching reasoning via content-free strategies is useless.

McMillan (1986) found twenty-seven college-level studies of the effects of methods, courses, programs, and overall college experience, on students' critical thinking. Few effects were found for any of the influences except overall college experience.

Deductive Evidence

The following exhortations assert that thinking in general and critical thinking in particular cannot be taught in a vacuum.

Gagne (1983) cautioned that content area knowledge was prerequisite to the successful teaching of critical thinking.

Bereiter (1984) also argued against teaching thinking skills in isolation from the content. Bereiter (1984) noted that his argument was distilled from fifteen occasionally frustrating years of school-based experiments on promoting thinking skills.

Even more fundamental is the argument of Dale (1976), among others, that vocabulary is prerequisite to critical thinking and that schools should use vocabulary development to enhance critical thinking.

McPeck (1981) argued that insofar as critical thinking involves skills, those skills should be teachable. Since there is no academic subject that is properly seen as critical thinking, it should be taught as an integral part of other subjects. He also argued that the affective domain is also involved as one must also be disposed to think critically.

Nickerson (1986) also argued strongly that thinking is a totally knowledge-dependent activity, i.e., to think, one must think about something.

Cuban (1984) articulated the compelling problems associated with the teaching of reasoning in the skills.

Facione (1984) expressed his concern over the chaotic character of the critical-thinking enterprise, noting the current furor to teach critical thinking on the one hand, and its unsystematic study on the other hand.

Rud (1986), in his review, concluded that critical thinking is a necessary but not sufficient component of philosophical thinking and that philosophy should form the armature of a curriculum.

An entanglement is that critical thinking is heavily, probably irretrievably, implicated with verbal ability (Follman, in progress).

Both the inductive and the deductive evidence cited above make a strong case that critical thinking cannot be learned in a vacuum, devoid of content.

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CRITICAL THINKING INSTRUMENTS: INSTRUMENTS OF PLENTY OR PLENTY OF INSTRUMENTS?

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There has recently been a "new wave," an explosion, of interest in the venerable construct of critical thinking. In this explosion, critical thinking instruments, tests, measures, phenotypes have not received correlative attention. The purpose of this article is to identify psychometrically sound "old wave" and promising "new wave" critical thinking instruments. "New wave" critical thinking literature is defined as that of the last three or four years.

An excellent, "old wave" analysis of 24+ tests of critical thinking was conducted by Stewart (1979).

A current overview of some 11 contemporary general-content critical thinking tests was provided by Ennis (1986).

Over the years, the "old wave" critical thinking research produced several instruments suitable for use as phenotypes, i.e., *A Test of Critical Thinking Form G* (junior high school through adult level) (*Form G*); *Watson-Glaser Critical Thinking Appraisal Form YM* (junior high school through adult level (*Form YM*); and *Cornell Critical Thinking Test Form Z* (junior-high-level students). In an analysis of these three critical thinking measures, *Form G* was found to be psychometrically superior as well as shorter (Follman, Miller and Burg, 1971). *Form G* and *Form YM* might be enhanced by updating and also psychometric refinement.

Another, relatively recent, critical thinking instrument is *The Curry Test of Critical Thinking* (Landis and Michael, 1981).

Stewart (1979) reported that five measures tested a fairly large number of critical thinking abilities: *Cornell Critical Thinking Test, Level X; Cornell Critical Thinking Test, Level Z; Logical Reasoning Test; Pearson-Hyram Test of Critical Thinking; and Watson-Glaser Critical Thinking Appraisal.*

Baker (1981) reported that the Illinois Critical Thinking Project had reviewed 38 critical thinking tests, and that he (Baker) had located several additional ones. Together with the "new wave" critical thinking instruments, including *The New Jersey Test of Reasoning, The Whimbey Analytical Skills Inventory* (Whimbey, 1985), and other tests, there now exists a useful body of phenotypes of critical thinking for most age levels, especially middle school and above. The similarity of the "new wave" critical thinking instruments to the "old wave" critical thinking instruments, and to language ability, verbal ability, IQ, etc., was reported by Whimbey (1985).

In 1985, 280,000 California eighth-grade students were to take a history-social studies test in which forty percent of the questions addressed critical thinking skills (Kneedler, 1986). Critical thinking was to be tested through multiple choice questions, student essay, and vocabulary. Twelve critical thinking skills were organized in three main areas: defining and clarifying the problem; judging information related to the problem; and solving problems/drawing conclusions.

The State of Michigan has approved the development of a test of students' critical thinking skills to be administered to fourth graders in 1986 (Ranbom, March 6, 1985). New Jersey (Whimbey, 1985) and Connecticut (Sternberg and Baron, 1985) are also developing critical thinking instruments. Ennis (1986) reported that critical thinking instruments were also being developed by the states of California and Pennsylvania.

Another recent instrument is *The Ennis-Weir Critical Thinking Essay Test* (Ennis, 1986).

Ennis (1986) concluded that needed are additional critical thinking tests for particular subject matters, more thorough testing of critical thinking subskills, critical thinking testing at the elementary level, and general improvement in critical thinking tests. He also noted that the tests are dependent on an underlying definition of critical thinking, and that there is no concensus on the definition.

Yeany, Yap and Padilla (1986) reported on the *Group Assessment of Logical Thinking*, a measure of performance of six Piagetian cognitive modes: conservation reasoning, proportional reasoning, controlling variables, probabilistic reasoning, correlational reasoning, and combinatorial reasoning; and also on the *Test of Integrated Process*

Skills, a measure of performance of five integrated science process skills.

Psychometric critical thinking articles were reported by: Ennis (1984, 1985); Morante and Ulesky (1984); Moss and Petrosky (Sept., 1983); Quellmalz (1985); Sternberg and Baron (1985); and Whimbey (1895). The Morante and Ulesky (1984) and Sternberg and Baron (1985) articles, respectively, describe the new critical thinking test development in New Jersey and Connecticut, respectively.

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